Pesticides and Pacific Salmon in the Bay−Delta System: Exposure, Response, and Impacts at the Scale of Natural Populations

Frank J Loge

Public Comments

No public comments were received for this proposal.

Initial Selection Panel Review

Proposal Title

#0233: Pesticides and Pacific Salmon in the Bay−Delta System: Exposure, Response, and Impacts at the Scale of Natural Populations

Funding:

Do not fund

Initial Selection Panel (Primary) Review

Topic Areas

- Life Cycle Models And Population Biology Of Key Species
- Environmental Influences On Key Species And Ecosystems
- Relative Stresses On Key Fish Species
- Salmonid−related Projects

Please describe the relevance and strategic importance of this proposal in the context of this PSP. How does the proposal address the topic areas identified above? What are the broader CALFED Goals this proposal may meet that are not accounted for in these specific topic areas?

The authors propose to use a sophisticated modelling approach to test the hypothesis that sublethal pesticide exposure limits salmonid productivity in the Bay−Delta. The approach rests on three parts: (1) Spatial analysis of salmon distribution and pesticide exposure throughout the Bay−Delta. (2) Laboratory ecotoxicological studies of sublethal effects of three types of pesticides on growth, immuno−competence, swimmng activity, predator detection and adult homing behavior. (3) Develop and apply a dose−structured dynamic life−cycle model that would combine results from (1) and (2) to assess the effects of pesticide exposure to populations of winter run Chinook and steelhead in the mainstem Sacramento below Shasta Dam. The proposal work would contribute to a life cycle model for winter run Chinook and steelhead, assess

environmental influences (pesticides) on key species (salmonids). However, reviewers questioned the central hypothesis of the modeling effort, namely that exposure to pesticides was the factor limiting salmonid populations in the Bay−Delta. Similar research is currently being done in the Columbia River, and this proposal would meet a Calfed goal of greater comparative research on salmon populations along the Pacific coast.

The budgets of proposals submitted in response to this PSP are larger, on average, than those submitted to CALFED in previous years. The Science Program is committed to getting as much science per dollar as is reasonably possible. With this commitment in mind, can the proposed budget be streamlined? If so, please recommend and clearly justify a new budget total in the space provided.

The GIS analysis of salmonid distributions as well as the pesticide application and other aspects to assess exposure is proposed to be done for the entire Bay−Delta area. Yet the modeling will be done only on populations in the mainstem Sacramento below Shasta Dam. Hence it seems that the funds requested to support these tasks could be significantly reduced.They are currently requesting $221,432. That could be cut in half to $110,000. The justification for the funds requested under 2.2.2.1 ($189,916) is not clear because the proposal implied that NOAA would be covering this. The rest of the ecotoxicological portion is projected to cost $807,542; reviewers suggested that some of the research being done as part of the Columbia study should be applicable to these questions and hence reduce the need for all of the proposed experiments. $632,853 for developing a model seems excessive, particularly given the reviewer concerns about lack of model validation and that the model may prove to be of limited usefulness. $120,063 for project management is a very large amount.

Evaluation Summary And Rating.

Provide a brief explanation of your summary rating and any additional comments you feel are pertinent.

This proposal requests a considerable sum that would consume a

significant fraction of the Science Program's budget. Reviewers expressed substantive concerns with the approach (inability to accurately assess pesticide exposure, lack of model validation, limited number of pesticides used with no attention to mixtures) so that the model may be just one more salmonid model with limited application. Because of these legitimate concerns, it seems unwise to risk such a large fraction of the Program's budget on this effort.

Selection Panel (Discussion) Review

fund this amount: $**0**
note:
do not fund

This project proposes a modeling test of the hypothesis that sublethal pesticide exposure has impacts on salmonids with 3 approaches: 1. Examine the spatial distribution of pesticides and salmon distribution. 2. Lab assays of the impacts of pesticides on salmonids. 3. Develop a model based on the first and second parts.

The Panel recognized one strength of this proposal is that it encourages greater comparative research, since they are doing similar studies on the Columbia River.

However, reviewers questioned both technical aspects and utility of this work. The GIS analysis of pesticide and salmon distribution is unlikely to provide adequately detailed information, the model would not be validated, and some lab studies seem unrealistic. For example, in the field, both prey and predator would be exposed to pesticides; in the lab only prey are exposed; they use a limited number of pesticides, and don’t consider mixtures of pesticides. This “May result in just one more salmonid model with no application.” In addition, the group is are already funded for similar work from NOAA and are doing very similar research on Columbia River salmon.

Panel Ranking: Do not fund.

Collaboration Panel Review

Proposal Title

#0233: Pesticides and Pacific Salmon in the Bay−Delta System: Exposure, Response, and Impacts at the Scale of Natural Populations

Final Panel Rating
superior

Collaboration Panel (Primary) Review

Collaboration:

Will the results of the collaborative effort be greater than the sum of its parts? Is it clear why the subprojects are part of a larger collaborative proposal rather than several independent smaller ones?

above average
Yes, clearly a collaborative project.

Interdependence And Integration:

Does the proposal have an example that clearly articulates the conceptual model of each subproject and how they link together as a whole? Are the boundaries of the study plans focused and cohesive, yet well delineated? Is there a plan for potential differences in the stages of subproject completion times? Are there clear plans for analyses and interpretations which seek to identify and quantify relationships among the data collected in various subprojects rather than separate analyses for each subproject?

above average
Conceptual models well described and provides linkage. Plans focused and delineated. Clear plans for analyses and synthesis.

Project Management:

Is it clear who will be performing management tasks and administration of the project? Are there resources set aside for project management and time given for investigators to

collaborate? Is there a process for making decisions during the course of the project? Are there acknowledgments of potential barriers to collaboration and explanations of how team members will overcome barriers particular to their institutions?

above average
Project management is clear with resources set aside. Time is provided for collaboration and process for decisions. No process for overcoming barriers is described.

Team Composition:

Does the lead principal investigator have successful management history and experience leading collaborative teams? Is it clear that all key personnel are committed to making significant contributions to the project? Do team members have complementary skills?

above average
PI has successful history and experience managing and leading collaborative teams. Skills are complementary.

Communication Of Results:

Is there a clear plan for comprehensive and cohesive reporting of project progress to the CALFED community?

above average
Communication of results includes: website, database, assessments and evaluations, reports to CALFED, peer−reviewed journal articles (fisheries, ecology, biology and engineering), and presentations at CALFED Science Conference, as well as national and regional, and workshops.

Additional Comments:

Collaboration Panel (Discussion) Review

Primary reviewer rated the proposal above average. Secondary reviewer considered the proposal as Superior for three

reasons: model would bring experimental parts together, formation of “blue−ribbon” panel to review project, proposed to use weblog as a way to manage the project. Secondary reviewer's main concern was that the subcontractor is the only participant from UC Davis. After discussion, secondary reviewer became convinced that NOAA and UCD would be contributing equally. Both agreed that the proposal was Superior.

Technical Synthesis Panel Review

Proposal Title

#0233: Pesticides and Pacific Salmon in the Bay−Delta System: Exposure, Response, and Impacts at the Scale of Natural Populations

Final Panel Rating
above average

Technical Synthesis Panel (Primary) Review

TSP Primary Reviewer's Evaluation Summary And Rating:

The underlying hypotheis is that pesticides are limiting the productivity of natural salmonid populations in teh Bay−Delta watershed. The proposed study will develop a life−cycle model of winter−run Chinook and steelhead in the watershed that incorporates the exposure to dissolved−phase copper, the organophosphate chlorpyrifos and the pyrethroid esfenvalerate. The three components of the study are: 1) set up a geospatial GIS database of salmonid location and pesticide exposure throughout the watershed, to yield an an exposure assessment of the salmonids as they move through the system. 2) Conduct laboratory exposures to link pesticide exposure to growht, immuno−competence, swimming activity, predator detection, and adult homing behavior. 3) Develop and apply a dose−structured dynamic life−cycle model that would then combine the exposure assessment with the effects data in order to assess the effects of the pesticide exposure to population numbers. The research addresses an important topic. The laboratory study would provide very important insight into the effects of the three chemicals on various parameters that are important contributors to population−level effects (parameters are: growth, cellular stress, survival, homing, reproduction, foraging behavior, swimming performance, predation, and immune competence – though not for all chemicals). But the value of

the other two project components is not as clear. With the limited data available for getting a good handle on actual levels of the three chemicals through space and time (see also below), and the fact that the fish are migrating through the system, it will be very difficult to accurately predict pesticide exposures. The model is a good (and important) first step, but its limitation to three chemicals and dissolved−phase levels only means that at this point it will not provide an overall estimate of the influence of pesticides on population levels. There is also no plan to validate the model. It appears that spatial/temporal levels of exposure will be assessed using available water quality data, pesticide application and use data, and land−use and cover data. This may not be sufficient to accurately assess the duration and magnitude of pesticide exposure of the salmonids during outmigration in the watershed. Many figures in the proposal were too small to read. An external reviewer commented that this research group may not be able to handle the additional workload of this project. E.g. Lead−PI Loge has already 10 ongoing projects (totaling $16M). It is unclear to what extend parts of this proposed research would duplicate components of the ongoing Columbia River Basin project.

Additional Comments:

SUMMARY OF EXTERNAL REVIEW: The goals, objectives and hypotheses were clear and consistent throughout the proposal. The research was well justified, with the project goal being very pertinent. The approach was generally considered to be valid. One reviewer mentioned that he/she would like to see the addition of an organo−metallic pesticide. Another reviewer felt that the ability to predict pesticide exposure (crucial to this project) would likely be rather spotty and not sufficiently comprehensive to scientifically support an exposure assessment. Moreover, it was unclear whether the project was focussed on concerns for exposures associated with rearing or migration during the corridor. Feasibility was generally considered to be good, except for the problem with the limited exposure data availability. If successful, the research would be expected to develop valuable products, including the GIS overlay onto existing maps. The capabilities

of the team were considered to be excellent. The authors have outstanding track records and publication records. Some external reviewers felt that the budget was reasonable. One reviewer felt that it may be more efficient to rely less heavily on the PIs and more on graduate assistants.

The underlying hypotheis is that pesticides are limiting the productivity of natural salmonid populations in teh Bay−Delta watershed. The proposed study will develop a life−cycle model of winter−run Chinook and steelhead in the watershed that incorporates the exposure to dissolved−phase copper, the organophosphate chlorpyrifos and the pyrethroid esfenvalerate. The three components of the study are: 1) set up a geospatial GIS database of salmonid location and pesticide exposure throughout the watershed, to yield an an exposure assessment of the salmonids as they move through the system. 2) Conduct laboratory exposures to link pesticide exposure to growht, immuno−competence, swimming activity, predator detection, and adult homing behavior. 3) Develop and apply a dose−structured dynamic life−cycle model that would then combine the exposure assessment with the effects data in order to assess the effects of the pesticide exposure to population numbers. The research addresses an important topic. The laboratory study would provide very important insight into the effects of the three chemicals on various parameters that are important contributors to population−level effects (parameters are: growth, cellular stress, survival, homing, reproduction, foraging behavior, swimming performance, predation, and immune competence – though not for all chemicals). But the value of the other two project components is not as clear. With the limited data available for getting a good handle on actual levels of the three chemicals through space and time (see also below), and the fact that the fish are migrating through the system, it will be very difficult to accurately predict pesticide exposures. The model is a good (and important) first step, but its limitation to three chemicals and dissolved−phase levels only means that at this point it will not provide an overall estimate of the influence of pesticides on population levels. There is also no plan to validate the model. It appears that spatial/temporal levels of exposure

will be assessed using available water quality data, pesticide application and use data, and land−use and cover data. This may not be sufficient to accurately assess the duration and magnitude of pesticide exposure of the salmonids during outmigration in the watershed. Many figures in the proposal were too small to read. An external reviewer commented that this research group may not be able to handle the additional workload of this project. E.g. Lead−PI Loge has already 10 ongoing projects (totaling $16M). It is unclear to what extend parts of this proposed research would duplicate components of the ongoing Columbia River Basin project.

Technical Synthesis Panel (Discussion) Review

TSP Observations, Findings And Recommendations:

Pesticides and Pacific Salmon in the Bay−Delta System: Exposure, Response, and Impacts at the Scale of Natural Populations

Panel was concerned that the study was limited to 3 chemicals and only in the aqueous phase of the chemicals. The reviewers felt that the choice of chemicals was not well justified. The panel indicated that the lack of a plan to validate the model was a concern. There were also concerns whether the group had the ability to do this project, because it is very ambitious and the researchers are apparently committed to a large amount of ongoing research. The panel considered this generally a strong proposal, and liked the overall approach. The panel noted that the researchers have done a similar study on the Columbia River, but it was unclear to them how the knowledge would be transferred.

One panelist had a concern about whether the GIS approach stated in the proposal would result sufficient data to meet the goals of this project. The use of chlopyriphos (banned for household use) was questioned, as future levels are expected to change from current conditions.

Pesticide as a sole factor limiting productivity worried reviewers. The panel felt that the budget was very high and

perhaps some of the work from the Columbia River work could be transferred and reduce the need for some of the laboratory exposures

Overall, the panel indicated the project component looking at effects on the large number of variables (including some tough variables such as predator detection and homing behavior)was very ambitious –– perhaps too much so.

Rating: above average

Technical Review #1

proposal title: Pesticides and Pacific Salmon in the Bay−Delta System: Exposure, Response, and Impacts at the Scale of Natural Populations

Review Form

Goals

Are the goals, objectives and hypotheses clearly stated and internally consistent? Is the idea timely and important?

Comments	**This is a large and complex proposal involving four distinct working groups. To successfully accomplish the goals and objectives will require a constant communication system and timely adherence to the plans of work. The hypothesis is straightforward and poses the question : Does pesticide exposure limit the productivity of natural salmonid populations in the Bay−Delta Watershed? This hypothesis, though simply stated, will require a highly integrated study employing a need for more "realistic" enpoints in exposing two fish species in a laboratory setting and correlating this to an extensive GIS database overlay and followed by extensive mathematical modeling of a suite of constitutive models that will be melded into a larger model framework. The objectives outlined above are clearly stated in sec. 1.1 and thematically reinforced throughout the proposal. The goals are well ordered in table 1 in a reasonable timeframe. A community website, blue ribbon panel, and monthy P.I. meetings are extremely necessary and well thought out. The scientific comcept is very timely in the field of Ecotoxicology and highly important as critical aquatic environments face risk from complex arrays of chemical stressors. We have approached such questions in my own research hence I can greatly appreciate their efforts and experimental systems. Complex environmental exposures are difficult to untangle even in compound field−laboratory studies in regards to complex**

	mixtures. The P.I's propose to develop an updated GIS map pertaining to pesticide use, propose a multi endpoint investigation on the effects of three different classes of pesticides representative of the study area relative to two fish species, and plan an integrated mathematical modeling effort for risk and predictive purposes. This large scale study requires an very multidisciplinary team of expertise. Of note, The chief PI. has a similar study funded and ongoing in the Columbia River Basin. This shoud co−reinforce and validate the overall approach.
Rating	**excellent**

Justification

Is the study justified relative to existing knowledge? Is a conceptual model clearly stated in the proposal and does it explain the underlying basis for the proposed work? Is the selection of research, pilot or demonstration project, or a full−scale implementation project justified?

Comments	**The study is well justified, a companion study is underway in the Columbia River Basin. I would like to see a dual watershed study undertaken in this area. The advantage here is a strong GIS database that can be accentuated by overlay of new information on human activities and pesticide usage. We have performed a similar operation regarding agrichemical usage in the Tallahatchee River Basin here in Mississippi and used this as a framework for both field, mesocosm, and laboratory studies with multiple species, toxicants, and endpoints. We do lack much of the superb modeling expertise that is presented on this research team. They will be able to accomplish much based on the success of completing the first two aims of the project. The ecotoxicological endpoints are well chosen and are more realistic indicators of species impairment on a functional level above more traditional biomarkers of exposure and effect. They will assay a broad suite of endpoint indicators from the molecular to the bahavioral and reproductive. This is the strongest and experimentally most ambitious**

	part of the study. The conceptual levels of the three aims and underlying rationale/details are clearly stated. Add the experiences of their Columbia River Basin work and this is a project ready for full implementation next October. This study may also conceptually integrate well to studies currently being funded by NSF in the "Bioconfluence" arena. They are complementary in nature.
Rating	**excellent**

Approach

Is the approach well designed and appropriate for meeting the objectives of the project? Is the approach feasible? Are results likely to add to the base of knowledge? Is the project likely to generate novel information, methodology, or approaches? Will the information ultimately be useful to decision makers?

Comments	**The approach and task plan are well constructed. The GIS work should be mostly completed by the end of the second year and updated by the end of the third. This is an excellent way to assess pesticide usage in the Bay−Delta area and is functionally critical to the modeling component. The P.I.'s propose and extensive laboratory exposure study using two salmonid species exposed to three pesticide class representatives: copper − a metal pesticide, chlorpyrifos − an organophosphate pesticide, and esfenvalerate − a pyrethroid pesticide. toxicant exposures will be separate and single in nature (no mixtures) based upon the general additive nature of effect of pesticides in aquatic systems. This is a generally accepted view. I would like to see addition of an organo−metallic pesticide such as MSMA which together with the other three might more fully cover the main representative pesticide classes used in large areas of the U.S. We have observed**

	possible non additive effects in our mixture studies. It might be interesting for the experimenters to add an environmentally relevant mixture exposure study in the third year of the study. The GIS and exposure elements of the study are will certainly expand the knowledge base but should especially input a more refined set of data into the complex model developments being proposed. It is truly stated that a model is only as good as the data upon which it is built but if well executed (esecially the laboratory exposure studies) it will work towards a much better understanding of the biological endpoints that are truely more critical for salmonid population survival. Novel knowledge could be gained as well as the utilization of some interesting new biological endpoints from the exposure studies. The proposers have well presented experimental and modeling evidence in support of their goals and objectives in the figures. Salmonid populations face threats other than chemicals. These are being studied but this plan could grealy help in assessing the overall risks to these important species from the host of human activities that includes habitat destruction, dams etc and developing remediation plans.
Rating	**excellent**

Feasibility

Is the approach fully documented and technically feasible? What is the likelihood of success? Is the scale of the project consistent with the objectives and within the grasp of authors?

Comments	**This plan is highly feasable considering that a related study is underway in the Columbia River Basin. Having this experience will allow this reaesrch team to jump right in this coming fall providing that the**

	most critical component involving the pesticide exposures is ready to go. A lot of fish will be required from the husbandry operations in a very timely manner. The exposure studies and endpoints are complex and will involve a lot of time and labor. Communication via the website and P.I. meetings is extremely critical for success as there are numerous snafus that might occur in this part of the task plan. A well ordered QA/QC plan must be put in place to deal with the large numbers of sample parts. All aspects of the proposed study are well documented, ordered, and explained. They have a strong detailed presentation backed by a significant knowledge base. The researchers are experienced to the extent that success is highly likely. A "big science" project approach is clearly outlined here
Rating	excellent

Monitoring

If applicable, is monitoring appropriately designed (pre−post comparisons; treatment−control comparisons)? Are there plans to interpret monitoring data or otherwise develop information?

Comments	This is a large and ambitious plan of work hence a solid monitoring plan is possibly the most critical component overall in regards to accomplishment of the objectives and goals. I have participated in a number of large multi P.I. /multidisciplinary studies and having a team website, oversight panel, periodic meetings, and the occasional retreat was essential. The proposers have this incorporated completely throughout the project period and task plans. This study could not possibly succeed without a strong communication setup. I would encourage periodic retreats involving all personel at least once or twice yearly. This has worked well for us. The amount of data and information to be handled will be considerable. The exposure studies will need a well ordered QA/QC plan and a detailed order of sample collection, processing, and analysis. The exposure

	studies will have the negative controls but I was not particularly clear if they had explained icorporation of a positive control in thier treatment groups. It was not clear as to the numbers of fish to be exposed/treatment group, and replicate structure especially for studies that will observe behavioral endpoints. Is this required in the proposal/plan of work? Addressing experiment treatment structure design is important even if only briefly addressed.
Rating	**very good**

Products

Are products of value likely from the project? Are contributions to larger data management systems relevant and considered? Are interpretive (or interpretable) outcomes likely from the project?

Comments	**Specific products could be developed as spinoffs from different components of the study. THe GIS overlay onto already preexisting maps would be a great resource with multiple uses on many levels. We are obtaining new benefits from our GIS work in watersheds in Mississippi in both practical applications and in proposing other research proposals. I am especially interested in some of the specific bioindicator assays they will be using such as the behavioral and reproductive tests. I am very interested in the cytokine rtPCR assays to measure immune competence. There should be a considerable contribution in regards to data management in this case the integration of GIS, tox endpoints, and modeling as this is often a formidable component. They have also indicated that considerable progress has been made in these areas as a result of the related ongoing project in the Columbia River Basin. Other studies regarding other toxicants such as PAH's, PCB, and other organics and non organics need to be performed along similar designs to get a better picture of risks to critical species hence this will be a major piece in the overall puzzle**

Rating	**excellent**

Additional Comments

Comments	**This is an excellent and large research team with a well established collaborative setup and track record in related studies. They have the experience gained from the ongoing related study in the Columbia River Basin and I an pleased with the proposed level of support from NOAA. They propose a significant investment in the project.**

Capabilities

What is the track record of authors in terms of past performance? Is the project team qualified to efficiently and effectively implement the proposed project? Do they have available the infrastructure and other aspects of support necessary to accomplish the project?

Comments	**The authors track record is outstanding. I wish they could have helped us on several large projects in our region at least in an advisory role. The research accomplishments of the P.I.'s and other personnel is excellent. They are certainly qualified and equiped to begin and have the basic infrastructure fully in place. Outside of labor costs, computer hardware, and supplies will be upgraded to handle the extensive data base and management issues. Much of the potential troubleshooting in regards to data aquisition, data management, laboratory exposures, and modeling are settled. The additional support from NOAA is excellent especially for all three project aims. Without this support It may not be do−able. The P.I.'s have experience working together and UC Davis has grown considerably in the research infrastructure needed for this ptroject. They are strong in capabilities needed for the three specific aims of the project**
Rating	**excellent**

Budget

Is the budget reasonable and adequate for the work proposed?

Comments	**The budget is reasonable. THe NOAA matching funds especially in regards to a number of exposure studies is excellent. A considerable amount of laboratory work will be performed thus at a reasonable cost. Cost for the GIS work for ain 1 and the modeling in aim 3 is very reasonable. Indirect cost rates are acceptable. The budget is very well detailed and presented by UC Davis. I would encourage the investigators performing the exposure study to possibly include an organo−metallic pesticide in the exposure study such as MSMA. Heavy metal species and their organic relatives may be an important element in the equation and if the funds permit do it.**
Rating	**excellent**

Overall

Provide a brief explanation of your summary rating.

Comments	**Overall, this is an excellent propsal. THe NOAA match makes this very attractive plus an experienced group of collaborators are ready to implement the project this October. The biggest strength is the ongoing Columbia River Basin study underway by Loge et al. This complements well. I have made a suggestion to possibly include an organo−metallic pesticide in the exposure studies. I would have liked a little bit more info on the general treatment structure and N values for the experiments. A positive control should be included and possibly a mixture exposure based upon environmentally relative levels of four pesticides (metal, orgallo−metallide, organophosphate, pyrethroid) might be interesting because of the**

	possibility of non additive effects, though the authors showed evidence of an additive effect in mixtures of organophosphates, they represent only a single classification of pesticide. I like the biological endpoints which include molecular, physiological, pathological, behavioral, and reproductive endpoints. This is an excellent hierarchy of biomarkers at different biological levels. Having been an Associate Editor for "Ecotoxicology" and currently serving on the editoriaol board, we encourage manuscript submission emanating from such studies. I would expect a nice series of publishable papers from this interesting effort.
Rating	**excellent**

Technical Review #2

proposal title: Pesticides and Pacific Salmon in the Bay−Delta System: Exposure, Response, and Impacts at the Scale of Natural Populations

Review Form

Goals

Are the goals, objectives and hypotheses clearly stated and internally consistent? Is the idea timely and important?

Comments	**The goals, objectives, and hypotheses are very clearly stated and are internally consistent. The idea is very timely and important.**
Rating	**excellent**

Justification

Is the study justified relative to existing knowledge? Is a conceptual model clearly stated in the proposal and does it explain the underlying basis for the proposed work? Is the selection of research, pilot or demonstration project, or a full−scale implementation project justified?

Comments	**The background to this project is clearly outlined by the author, who has extensive experience in this field. The conceptual model is clear and explains the underlying bases for the proposed studies.**
Rating	**excellent**

Approach

Is the approach well designed and appropriate for meeting the objectives of the project? Is the approach feasible? Are results likely to add to the base of knowledge? Is the project likely to generate novel information, methodology, or approaches? Will the information ultimately be useful to decision makers?

Comments	

	The approaches proposed are excellent and helped measurably by the collaborations that are proposed. The PI is using similar approaches in a project in the Columbia River Basin, so the necessary experience is present. The approaches are certainly feasible, given the group expertise. This information will be important in making management decisions in California. The multiple approaches will certainly generate novel and important information and methodology.
Rating	**excellent**

Feasibility

Is the approach fully documented and technically feasible? What is the likelihood of success? Is the scale of the project consistent with the objectives and within the grasp of authors?

Comments	**With the background and experience of the PI and this proposed group, the work is certainly feasible, with a great likelihood of success. The scale of the project is correct.**
Rating	**excellent**

Monitoring

If applicable, is monitoring appropriately designed (pre−post comparisons; treatment−control comparisons)? Are there plans to interpret monitoring data or otherwise develop information?

Comments	**The proper controls are outlined for all the experiments.**
Rating	**excellent**

Products

Are products of value likely from the project? Are contributions to larger data management systems relevant and considered? Are interpretive (or interpretable) outcomes likely from the project?

Comments	**I don't see any specific products, but there certainly will be contributions to larger data management systems.**
Rating	**excellent**

Additional Comments

Comments	**There is little doubt that this is the right group to do this important study. But one has to wonder just how much more state and federal funding should be invested in this group. It appears that the PI has ca. $26 million currently funded in grants and contracts! Surely, other groups who are seeking similar funds should be considered.**

Capabilities

What is the track record of authors in terms of past performance? Is the project team qualified to efficiently and effectively implement the proposed project? Do they have available the infrastructure and other aspects of support necessary to accomplish the project?

Comments	**The past performance is astonishing. The team is certainly qualified and well supported in terms of infrastructure and expertise.**
Rating	**excellent**

Budget

Is the budget reasonable and adequate for the work proposed?

Comments	**The budget seems appropriate.**
Rating	**excellent**

Overall

Provide a brief explanation of your summary rating.

Comments	**Despite the overall excellence of this proposal, I am ranking it "very good" because I think that this group has more than sufficient funds to keep it working full time. Indeed, one has to wonder how so many projects can be handled by a single group.**
Rating	**very good**

Technical Review #3

proposal title: Pesticides and Pacific Salmon in the Bay−Delta System: Exposure, Response, and Impacts at the Scale of Natural Populations

Review Form

Goals

Are the goals, objectives and hypotheses clearly stated and internally consistent? Is the idea timely and important?

Comments	**Goals, objectives and hypotheses are clear and consistent throughout proposal. Concept of research is timely and highly valuable to enhancing recovery of California's anadromous salmonid fish populations.**
Rating	**very good**

Justification

Is the study justified relative to existing knowledge? Is a conceptual model clearly stated in the proposal and does it explain the underlying basis for the proposed work? Is the selection of research, pilot or demonstration project, or a full−scale implementation project justified?

Comments	**Research is well justified. The project goal on pesticide impacts on anadromous fishes is a very pertinent and a highly probable source of mortality affecting salmonid fish recovery in the Bay−Delta Watershed. Use of current and relevant literature appears reasonable. The conceptual design of the project is clearly presented.**
Rating	**very good**

Approach

Is the approach well designed and appropriate for meeting the objectives of the project? Is the approach feasible? Are results likely to add to the base of knowledge? Is the project likely to

generate novel information, methodology, or approaches? Will the information ultimately be useful to decision makers?

Comments	**Parts of the project are well designed to meet project objectives. Aim 2 will provide the most immediately useful information to decision makers. Aim 1 has the potentially least value to the project, mostly because of limited and applicable data bases. The logic seems flawed that GIS data can provide a composite of sublethal pesticide exposures, especially when anadromous fish are migrating through the corridor. Getting pesticide exposures seems incredibly difficult with different soil types, flows, climatic events, etc. Experience with state and federal data bases has demonstrated that much of the data is of questionable value as its precision and accurracy is in doubt. This project is predicated on the ability to predict pesticide exposure. This aspect is likely to be very spotty and not sufficiently comprehensive to be able to scientifically support an exposure assumption.** **If the research were funded, there needs to be another aspect and that validation. This could be done by comparing output results from the model and SARs (smolt to adult returns) to validate the model; i.e. if more than 100% mortality were attributed to pesticide exposure results would limt their potential application or conversely, low mortality would be questioned also.** **Responses to various environmental insults often vary considerably among conspecifics. If "substitute" species (coho salmon) were needed, I believe similar tests on the substitute would be critical to extrapolating to the target species, steelhead and Chinook salmon.** **Application of a bioenergetics model (Study 3.−Task 2.2.2.3)is unclear. These models either vary food intake or thermal environmental conditions. Their application is unclear with the current design.**

	Application of the 3 dimensional imaging system under Study 2.–Task 2.2.2.4 is also not clear. Why not use a purely quantifiable and well accepted approach such as swimming stamina? This technique will provide a highly quantifiable measure of swimming behavior rather than introducing subjectivity to fish position.
Rating	**fair**

Feasibility

Is the approach fully documented and technically feasible? What is the likelihood of success? Is the scale of the project consistent with the objectives and within the grasp of authors?

Comments	**I am a little unclear about choice of species and concerns for exposures. Are exposures associated with rearing or migration through the corridor? Choice of fishes then is critical as each species has different rearing durations; steelhead should probably be used to examine pesticide exposure under extended rearing conditions whereas Chinook salmon should be used as impacts on another species migrating through the migration corridor. Concerns about exposure to pesticides during migration and relating that to existing data appears weak as these fish typically migrate through the corridor at highest flows when dilution is greatest and fewest samples are collected. This needs to be clarified in the proposal.** **Because of the probable limited exposure data, the life–cycle modeling effort will become more of a simulation model that will be another one of many available. The application of this type of model to the Columbia River system with "dam" exposures, a very data rich system, seems much more feasible than in a system like the Bay–Delta Watershed of limited data. Consequently, Aim 3 will probably provide limited information.**
Rating	**fair**

Monitoring

If applicable, is monitoring appropriately designed (pre−post comparisons; treatment−control comparisons)? Are there plans to interpret monitoring data or otherwise develop information?

Comments	**As indicated earlier, I believe a comparative aspect to the life − cycle model is necessary to "validate" the model output. I would imagine that SARs are known for various stocks within the Bay−Delta Watershed. Comparison of these with model outputs would provide a measure of "reality" and could enhance the models acceptability and ultimately, application within this system.**
Rating	**poor**

Products

Are products of value likely from the project? Are contributions to larger data management systems relevant and considered? Are interpretive (or interpretable) outcomes likely from the project?

Comments	**Products from this research could be extremely valuable by enhancing the understanding of salmon life−cycle exposed to pesticides in this Watershed with broad application to other watersheds. If successful, outcomes would be highly valuable and provide additional evidence of anthropogenic impacts on salmon recovery. The proposed model could be a major "tool" for managers to assess viability of restoration programs.**
Rating	**very good**

Additional Comments

Comments	**I believe this research would be more effective and more likely to succeed with a phased approach. The success of the project is so intimately related to assessing exposure to pesticides and that appears as a**

	possible weak link. In the first phase, the PIs could demonstrate the availability of the data to a "Panel" and then decide if the data were sufficient to progress with the othe two major phases (laboratory assessments and modeling). Regardless,information that is directly attibuted to where and when the fish are at an "exposure" location and for how long is pivotal to the project's success.

Capabilities

What is the track record of authors in terms of past performance? Is the project team qualified to efficiently and effectively implement the proposed project? Do they have available the infrastructure and other aspects of support necessary to accomplish the project?

Comments	The track record of personnel listed on the proposal is very impressive. They have strong records of publications which attests to their ability to complete projects. The academic committments of PIs are not presented which makes it difficult to evaluate their projected time commitments. Two of the PIs may be too successful and be spread a little thinly to contribute the specified amount to the project. Specifically, the Project Manager and lead PI, Dr. Loge. He has listed 10 active projects while Dr. Quinn has listed 22. Both of these scientistws are scheduled for significant time commitments the first year; Dr. Loge is committed for 174 hours in 2005 while Dr. Quinn in committed for 347 hours. Additionally, Dr. Loge has 348 hours of project management in 2005. Collectively, that is more than 13 weeks of time which seems excessive considering his involvement in other projects and being responsible for millions of dollars of research monies.
Rating	good

Budget

Is the budget reasonable and adequate for the work proposed?

Comments	**The proposal lists a total of 17 different personnel on this project. Eleven are research personnel, Post−Docs and Graduate assistants, and the remaining 6 are PIs. Consequently, I believe the overall budget may be higher than necessary because of the excessive time committments of the two PIs (Loge and Quinn). This money might be better directed to additional Graduate Assistants.** **The proposal was unclear about the cost of Dr. Scholz's contribution to the project. Initially, the proposal indicated that his involvement was a donation by NOAA Fisheries. However, the toal cost of his component seems to exceed 25% of toal project cost.**
Rating	**good**

Overall

Provide a brief explanation of your summary rating.

Comments	**I believe this proposal represents a major effort and potentially a major contribution to the life−cycle impacts of pesticides to anadromous fishes. The personnel associated with the project are proven researchers with great track records. Some though, may possibly be too successful. Some PIs appear overly committed to other research projects to be able to contribute their proposed effort. The project seems predicated on the availability of sufficent data to accurrately predict pesticide exposure. The major limitation, however, appears to be in being able to "track" fishes associated with various pesticide exposures. Experinece has shown this reviewer that much of the data available on federal and state data bases is of questionable accurracy and precision. Availability of data that coincides with exact timing of rearing and migration may be highly limited which would render much of the proposed modeling output**

	little more than another simulation model with limited application. Also, some validation needs to be included. Something like comparing smolt numbers to returning adult numbers seems imperative to assess the validity of the output. Otherwise, this may turn out to be another research project with greater scientific "shelf" value than applied value.
Rating	**good**